Data From Mopra

User Manual

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31/10/2003

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1. Introduction- What is DFM?

DFM is a GUI interface to SPC, the spectral line reduction program used to process Mopra and Parkes data. It is designed to enable the novice user to quickly and easily reduce dual-polarisation position-switched data into a format usable by other programs such as CLASS and XS.

DFM contains the following features:

- Automatically forms a quotent from signal and reference spectra on loading data.
- Supports the following modes of position switching: ref-sig, sig-ref, ref-sig-sig-ref, sig-ref-ref-sig.
- Switches data to the LSR-K reference frame on load.
- Allows seperate and independent reduction of both polarisation quadrants
- Allows the user to inspect and flag bad scans in one click,
- Aligns and averages scans in velocity space, weighted by (Integration Time)/$Tsys^2$.
- Correctly averages polarisation A and B together using correct header data.
- Provides an interface fit polynomials to scan baselines with the option of accepting or rejecting the results in a single click.
- Allows the user to zero portions of the any scan.
- Allows the user to shift the velocity scale on any scan based on the desired zero velocity frequency.
- Supports input of both .rpf and .sdf format data
- Supports output in .sdf, .fits and .ps formats.
- Corrects for the “Parkes Scaling Error” automatically for data prior to 05/09/02.

All of the above tasks may be performed manualy on the command line using spc, however this would be a long and involved process. DFM automatically compensates for quirks in SPC that might result in errors in the reduced data, should the user not be aware of them and take the appropriate steps.

2. The User Interface

2.1 The Load Panel

Dir	Directory containing input file
File	Input file name with extention
Settings	Displays the settings menu.
	• Type of file being read.
	• Accumulate individual integrations from a single position? (rpf files only).
	• Correct for the *Parkes Scaling Error*?
	• Form a quotient from Signal – Reference?
	• Order of the scans in the file (Ref, Sig.....)
Load	Load the file into the registry,
	• Switches to the LSR-K reference frame.
	• Form the quotients and plot the 1st scan

2.2 The Information Panel

Src	Source Name of the current scan.
Date	Date of observation
Freq	Frequency of Polarisation A (1st Quadrant).
BW	Bandwidth of Polarisation A
RA	RA in J2000
DEC	Dec in J2000

2.3 The Scan Panel

Green Box	Current scan / register displayed
Long Box	Selectable list of scans
	• Select or de-select individual scans to average together.
	• Clicked scans will be displayed and the values in the *Information Panel* will update accordingly.

2.4 The Message Panel

Blue Box	Messages and feedback • Error and confirmation messages. • Tsys and Integration Time for the current scan.

2.5 The Action Panel

Pol A / B	Toggles between Polarisation A and B
Sel & Average	Aligns and averages the selected scans in the current polarisation. Saves the result and remembers the scans selected.
Av A & B	Averages the results from “Sel & Average” on Pol A and Pol B (Only available if Pol A and Pol B have been averaged)
Fit Baseline	Displays the Fit Baseline Dialog • Fit a polynomial to the baseline (order 1-5).
Zero Channels	Displays the Zero Channels Dialog • Zero a selected range of channels.
Shift Vel	Displays the Shift Velocity Dialog • Calculates a velocity shift based on a difference in zero velocity frequency and a user specified frequency. • Velocity shift can be specified manually.

2.6 The Save Panel

Dir	Directory to write out to.
File	File name prefix
File Type	Choose format of output file (.sdf, .fits, .ps)
Save	Save a the currently displayed scan using a the options specified above.
Quit	End the program and save the settings last used.

3. Reducing Position Switched Data

3.1 Preliminary Information - Register Usage

SPC has a maximum of 256 registers which may be used to store scans. DFM reserves six registers for its own use meaning that files containing more than 250 individual positions (Sig or Ref) will need to be split.

In an individual scan Pol A data is stored in Quadrant 1, while Pol B data is stored in Quadrant 2.

If a data file contains n scans corresponding to n individual positions then the 6 registers immediately after the nth scan will be used in the reduction process. The usage is allcoated as so:

Register	**Usage**
N	Last scan in the data set.
N+1	Average of selected Pol A scans (Quad 1)
N+2	Average of selected Pol B scans (Quad 2)
N+3	Average of Pol A & B scans (Quad 1)
N+4	Copy of Pol B scans copied to Quad 1(Save)
N+5	Temporary (Scratch) Register
N+6	Copy of Pol B scans copied to Quad 1(Av A&B)

3.2 The Settings Dialog

Before loading a data file it is necessary to tailor the file loading options to the data. Click on the ***Settings*** button to display the settings dialog.

Choose the file-type, both sdfits and rpfits are supported.

Depending on the schedule file used during the observations adjacent scans may need to be accumulated together. This will be the case if the telscope dumped data to the file more than once per pointing. Choose ***Auto*** if you want to accumulate the individual integrations or straight otherwise. Note- this option is only available when loading raw RPFits files.

Data taken before 5th September 2002 is affected by a scaling error introduced in the Telescope Control Software. The amplitude of the Pol A data was multiplied by 1.51 and Pol B by 1.73 before being written to the file. Selecting the ***TCS Scaling Error Correction*** checkbutton implements a routine that removes these scaling factors from each scan based on the date of observation. If you are loading previously corrected data from an sdf file you should turn this option off.

You can choose to form quotient scans from the reference and signal positions at load time. Four observation schemes are supported at the present time:

1. Reference – Signal
2. Signal – Reference
3. Reference – Signal – Signal – Reference
4. Signal – Reference – Reference – Signal

These settings will be retained in a text file called .dfm_settings in your home directory and read each time the program is started.

When finished click OK to dismiss the ***Settings Dialog*** and save the settings.

3.3 Loading a Data File

After configuring the load settings as above, type in the full directory path to your data directory in the field labeled ***Dir***. It is necessary to enter the last "/" in the path eg: **/home/crp/data/**

Type in the full file name, including extention in the field labeled ***File*** and click the ***Load*** button. The data file will be read and loaded into memory using the options specified in the ***Settings*** dialog.

On load the following tasks are performed:

> **Accumulate** (optional)**:** RPFits files only. Concatenate all adjacent scans beloging to a single position.
>
> **Rvel:** Switch all scans to the LSR-K reference frame.
>
> **Scale Err** (optional)**:** If the observations were taken before 05/09/2002 correct the amplitude of all the scans for the *Parkes Scaling Error*.
>
> **Quotient** (optional)**:** Form the quotient based on the observing scheme specified in the settings dialog. The algorithm used is $Q = (T_{ref}.S)/R - T_{sig}$ where T_{ref} and T_{sig} are the system temperatures of the reference and signal spectra. Q, S, R are the quotient signal and reference spectra.

A list of the scan numbers loaded appears in the ***Scan Selection Panel*** and the first scan is displayed in the PGPLOT window.

3.4 Examining Data

The scan selection panel contains a list of all scans loaded into memory in the current polarisation. Clicking on a scan number causes it to be displayed in the PGPLOT window and selects it for averaging (highlighted in colour). Clicking a highlighted scan dedelects it.

The green box contains the number of the currently displayed scan.

3.5 Averaging Single Polarisation Data

Data from a single polarisation may be averaged together by clicking the ***Sel & Average*** button. Highlighted scans are aligned in velocity space and then averaged together, weighted by (Int Time) / $Tsys^2$. The result is stored in reserved register and plotted for inspection. The selections made may be specific to a single polarisation and both the result and the scans selected for averaging are remembered by DFM.

3.6 Changing Polarisation

You may toggle between polarisation at any time by clicking on the button labeled ***Pol A*** / ***Pol B***. If you have already averaged scans from one polarisation the result will be displayed upon returning to that polarisation, additionally the individual scans selected for averaging will be retained.

3.7 Averaging Dual Polarisation Data

Dual polarisation data may be combined by first averaging data from each polarisation individually and then combining the two results. When both Pol A and Pol B data has been averaged (using the ***Sel & Av*** button) the ***Av A & B*** button will become active. Clicking this button averages the Pol A and Pol B data together weighted by (Int Time) / $Tsys^2$. The resultant scan is stored in quadrant 1 (Pol A) of a reserved register and plotted for inspection.

3.8 Fitting a Baseline Polynomial

A polynomial of order 1-5 may be fitted to the currently displayed scan. Click on the ***Fit Baseline*** button to display the ***Baseline Fitting Dialog***. The x-axis of the plotted spectrum will change from velocity to channel number. The baseline is fitted using two "baseline boxes" - regions of the

spectrum absent of any spectral lines. Choose two baseline boxes from the plot and enter in their channel ranges in the fields provided, eg: **1075-1375** and **1698-1998**. Be wary of syntax mistakes here as SPC will return rubish results if you enter a text character by mistake. Choose the order of polynomial to fit (1-5) from the menu at the top of the dialog box.

Click on ***Fit*** to see the effect of your chosen fit. If you wish to try again with new settings simply click ***Revert*** to return to the original scan. When you are happy with the fit click ***Apply***, changes will be saved to the scan and the dialog box will close. ***Cancel*** aborts any changes made and exits from the dialog box.

3.9 Zeroing Channels

Occasionally it may be necessary to set some chanels in an individual scan to zero, particiularly at the edges of the bandpass. Click on the ***Zero Channels*** button to bring up the ***Zero Channels Dialog***. The x-axis of the plotted spectrum will change from velocity to channel number. Enter the range of channels to be zeroed in the fields provided and click ***Zero*** to test. ***Revert*** returns to the original scan. When you are happy with the result click ***Apply***, changes will be saved to the scan and the dialog box will close. ***Cancel*** aborts any changes made and exits from the dialog box.

Note: To achieve good results with this tool it may be necessary to fit a baseline to the scan in quiestion first.

3.10 Shifting the Velocity Scale

When observing molecules with multiple transitions it may be necessary to shift the velocity scale on the scans so that the zero position corresponds to a particular line. It is also possible that the wrong frequency was centred in the bandpass due to errors while observing or otherwise.

Click on the ***Shift Velocity*** button to display the Offset Velocity Dialog. The current zero velocity frequency is displayed (as requested at the telescope and uncorrected for VLSR of source). If this frequency is different from the desired frequency simply enter in the desired zero velocity frequency and click ***Calculate*** to compute the necessary velocity offset. The calculated offset will appear in the ***Velocity Offset*** field. Alternatively the desired offset may be entered manually. The ***Test*** button shifts the scale by the desired amount, ***Revert*** returns to the last scan. ***Apply*** causes the changes to be saved to the scan and exits the dialog box. ***Cancel*** aborts any changes made and exits the dialog box.

3.10 Saving Results

The currently displayed scan (indicated by the green box) may be saved at any time simply by clicking on the ***Save File*** button. In the field labeled ***Dir*** enter the full path to the directory you wish to write files to. You must include the trailing "/" as in the load panel. The ***File*** field contains the prefix of the file to be saved, by default this is the source name as read from the input file.

Select your desired file type from the ***File Type*** menu. Supported types are SD-Fits and Fits and Postscript plots. Click on **Save Files** to write the file.

Note: it is not possible to overwrite files of the same name.

3.11 Quitting

To exit the program click the ***Quit*** button. The choices made in the Settings dialog will be saved to a text file named .dfm_settings in your home directory. DFM will read this file on the next startup.